Model 702 pH Monitor
Installation
and
Operation Manual

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1.0 General Information Model 702 pH Monitor

The Model 702 pH Monitor together with a Model B605 Inline sensor (available in 1/2" to 2" line sizes) is specifically designed for sanitary applications. The sensor is CIP and SIP sterilizable. The materials of construction, 316 Stainless Steel, Kynar^{tm} and application specified gasket materials are ideally suited for biopharmaceutical processes.

The pH electrode supplied, as standard with the Model 702 pH Monitor, is manufactured by Innovative Sensors, Inc. This electrode is specifically designed for biotech applications The standard pH probe supplied is a 12 mm diameter probe with a 120 mm insertion length. Probes by other manufacturers can be used if they are mechanically compatible.

The Model 702 is typically used for inline, sanitary pH readings of bulk or transfer bioprocess fluids when pH control is critical. Chromatography, fermentation and bulk storage of biological solutions are examples of operations where maintaining pH is most important. The Model 702 ensures the viability of biological species and products during these operations or any bioprocessing step. The easy electrical interface allows overall process schemes and more sophisticated control strategies to be designed and used.

The Model 702 pH Monitor has a user selectable full range of 0 -10 pH, 2 -12 pH or 0 -14 pH. The monitor's voltage and current outputs track the selected pH range. The resolution is +/- 0.01 pH with an accuracy of 0.5% FS at 25^{o}C. Temperature compensation is user selectable to be automatically or manually adjustable from 0 to 100^{o}C. When used in conjunction with the Model 722 combined Conductivity and Temperature Monitor, the signal for the pH temperature compensation is provided by the Model 722 temperature output. The Model 702 is housed in a DIN 35 mm Rail mount enclosure.

2.0 Specifications
2.1 Model 702 pH Monitor

pH Range:	0-14
Resolution:	+/-0.01pH
Accuracy:	+/- 0.5% FS at 25^{o}C
Temp. Compensation:	Manual or Automatic (user selectable), 0-100^{o}C
pH Input Impedance:	>10^{15} ohms
Output Range:	0-10, 2-12 or 0-14 pH Full Scale (user selectable)
Analog Outputs:	Voltage: 0-2 vdc, 10,000 ohms load Current: 4-20 mA, 600 ohm max.
Power:	115/230 VAC +/- 15%, 50-60 Hz., 5.0 watts Optional 20-28VDC 3W
Dimensions:	119 mm(4.69”) high, 75 mm(2.91”) deep by 100 mm(3.94”) wide rail mount enclosure constructed of ABS and glass filled polycarbonate
Weight:	Module less than one kilogram

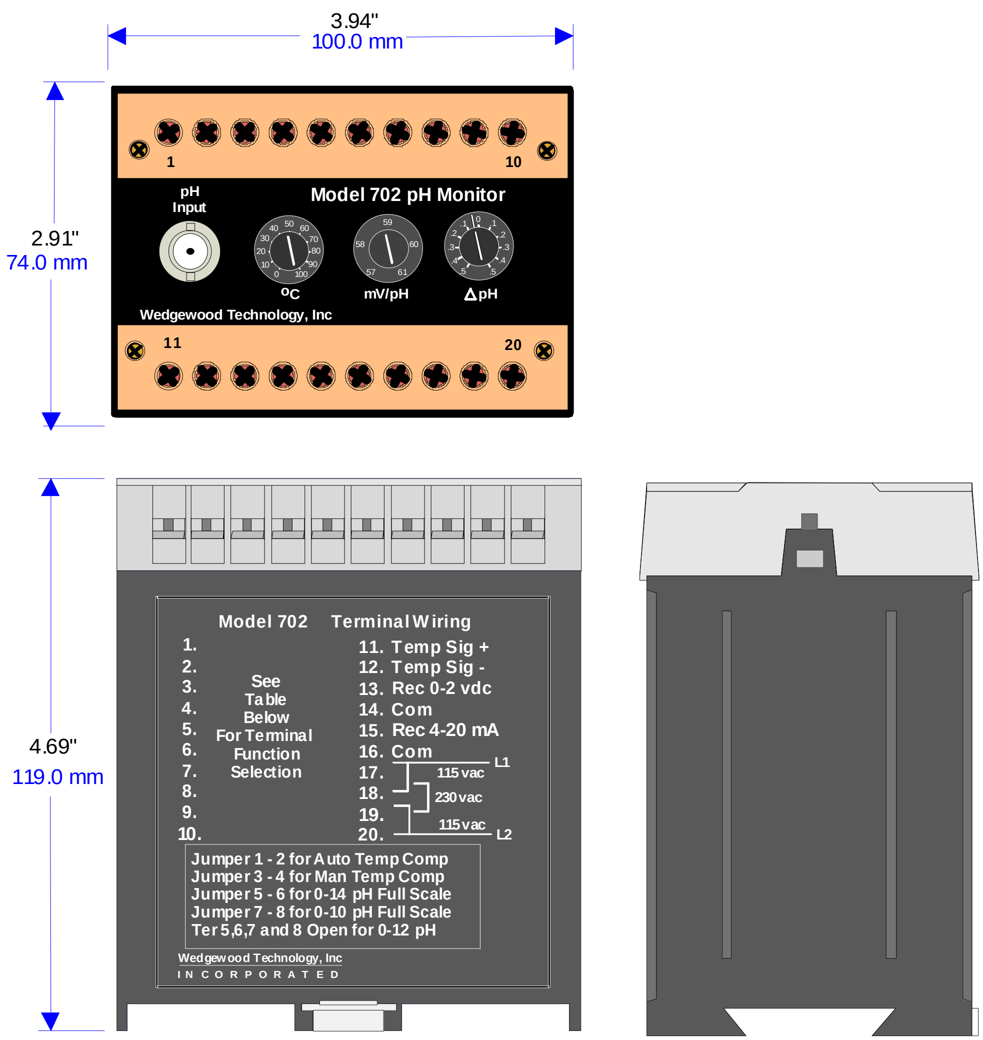

Fig. 1. Model 702 Mounting Dimensions

2.2 pH Probe and Inline Sanitary Sensor

Line Size:	1/2" to 2" Tri-Clover Sanitary Flange (up to 4" available)
Flowcell Material:	316L Stainless Steel, other materials available
Gaskets:	Viton, EDPM, Silicon, EPR
Temperature Range:	0 to 130^{o}C
pH Probe:	12 mm Diameter., 120 mm Long, Steam Sterilizable
Type:	Combination, Gel Filled

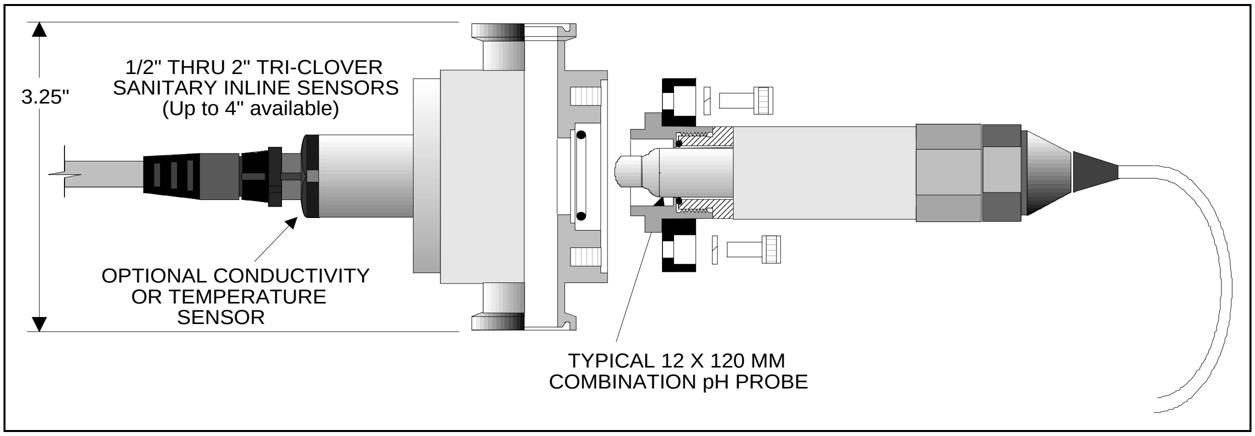

Fig. 2. Typical B6xx Inline pH Sensor

3.0 Installation

3.1 Transmitter Installation

Inspect the modules, sensors and cable for any signs of shipping damage. Report any visual damage or discrepancies to Wedgewood Analytical and the Shipper.

The pH combination electrode is in the manufacturer's original packaging. **It is shipped in a 4.0 pH buffer solution and should not be removed from this storage until the electrode is placed in operation.**

The Model 702 pH Monitor is a DIN 35MM Rail mount enclosure which can be mounted or installed on a vertical or horizontal surface. Refer to figure 1 for mounting dimensions. Mount or install the transmitter on a surface that is not subject to excessive vibration or shock. Allow enough clearance for easy cable entry.

3.2 Electrical Connection

All electrical and sensor input connections to the Model 722 are located on the front of the module. A Terminal Wiring Label can be found on the side of the module. Refer to this label and the wiring diagram (figure 3 for AC input model) (figure 4 for DC input model) for electrical installation.

When routing cables, we recommend always separating the pH sensor cable from input power wiring. All pH sensor cables supplied are terminated at both the sensor and transmitter ends.

Connect input power according to type available. ***Units are configured at the factory as AC or DC versions. Check configuration before connecting***.

Select 0 -14pH, 2 - 12pH or 0 - 10pH Full Scale and Automatic or Manual temperature compensation by installing a hard wire jumper or dry contact closure across the appropriate terminals.

When connecting to analog outputs, we recommend the use of shielded twisted pair cable. Terminate cables ends as shown in figure 5 and connect as in figure 3 / figure 4.

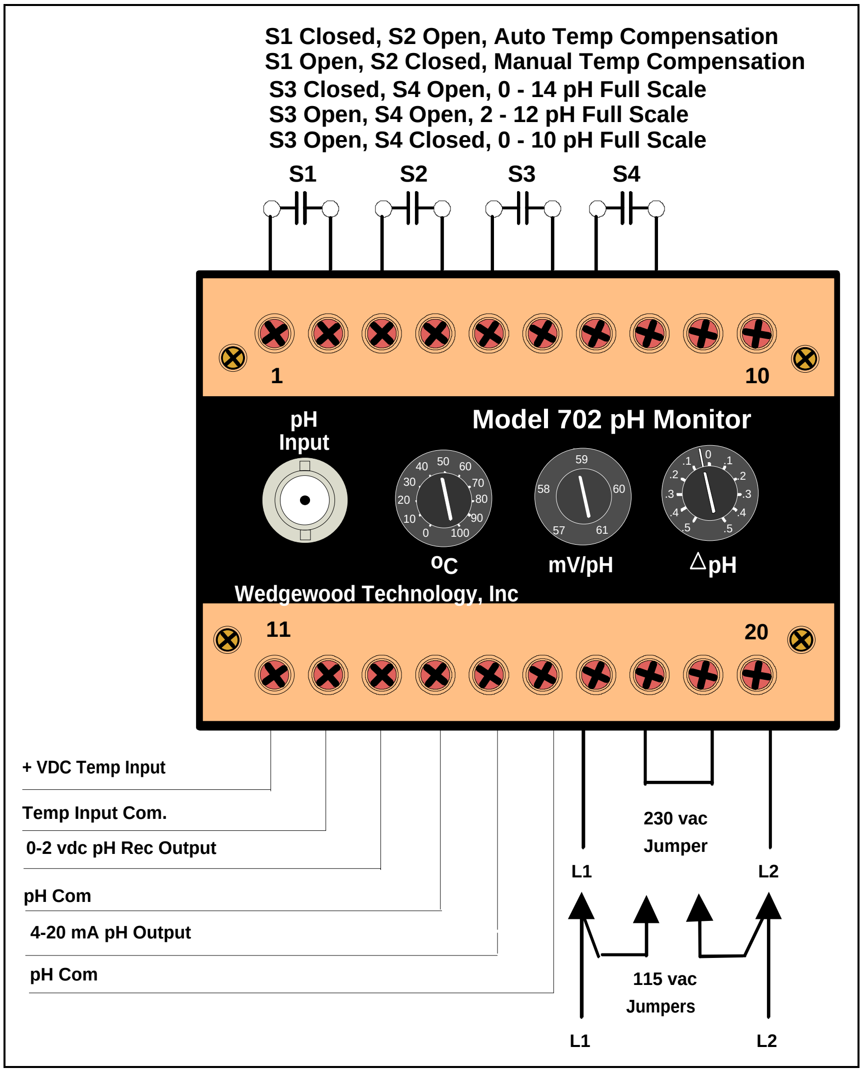

Fig. 3. Model 702 (AC Input Version) Wiring Diagram

On models equipped with the 24 VDC option, the input connections may be "daisy chained" to other 700 series equipment. Both pairs of terminals, 17-18, 19-20 are connected together to allow in-out power connections. Refer to figure 4.

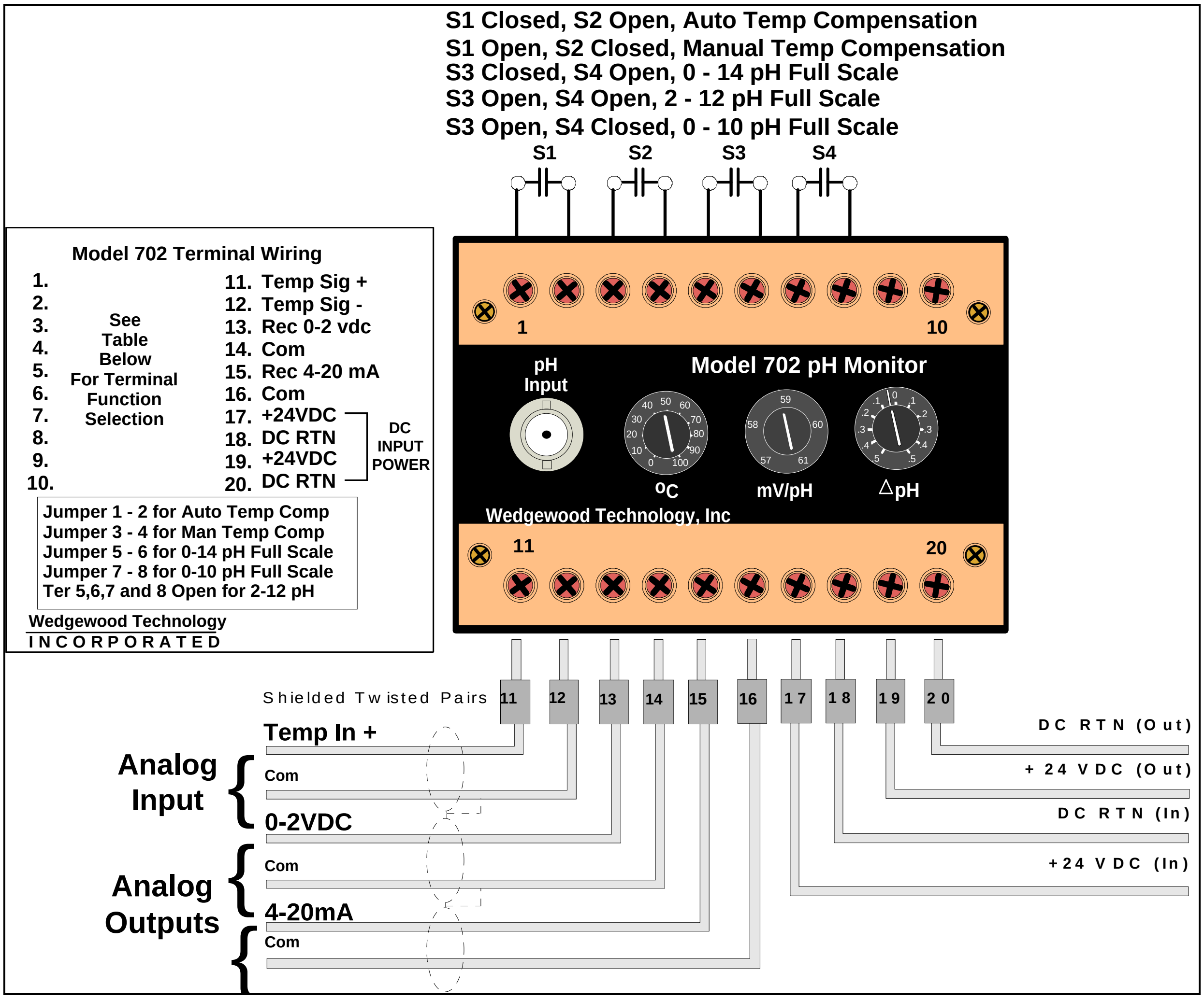

Fig. 4. Model 702 (DC Input Version) Wiring Diagram

The preparation of the wiring before connecting to the module terminals is shown in Figure 5. It is recommended that all wires be terminated with wire pins. The wire and the pins should be soldered after crimping to insure a good electrical connection.

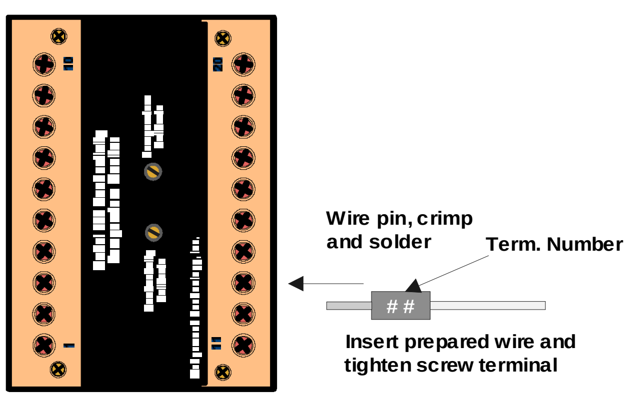

Fig. 5. Terminal Preparation and Connector Assembly

4.0 pH Sensor and Electrode Installation

The sensor should be located in the piping system so that the pH probe is at least 15 degrees above a horizontal plane. The pH probe contains liquid solutions that must remain in contact with their respective junctions hence the reason for placement of the sensor so that the pH probe is above the horizontal plane.

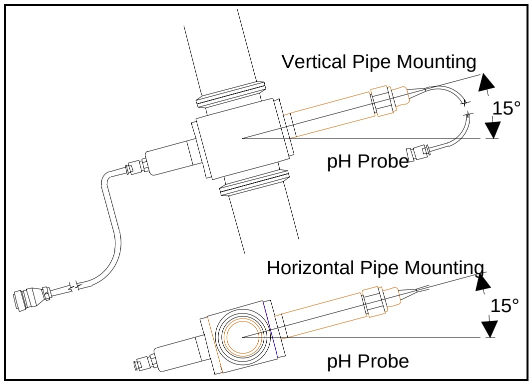

Fig. 6. Minimum Angle of pH Electrode Installation on Typical Piping Systems

Since the pH electrode must remain wetted at all times, the sensor should be positioned so that the flowcell will be filled with a liquid during standby or that the pH electrode is easily removed for storage.

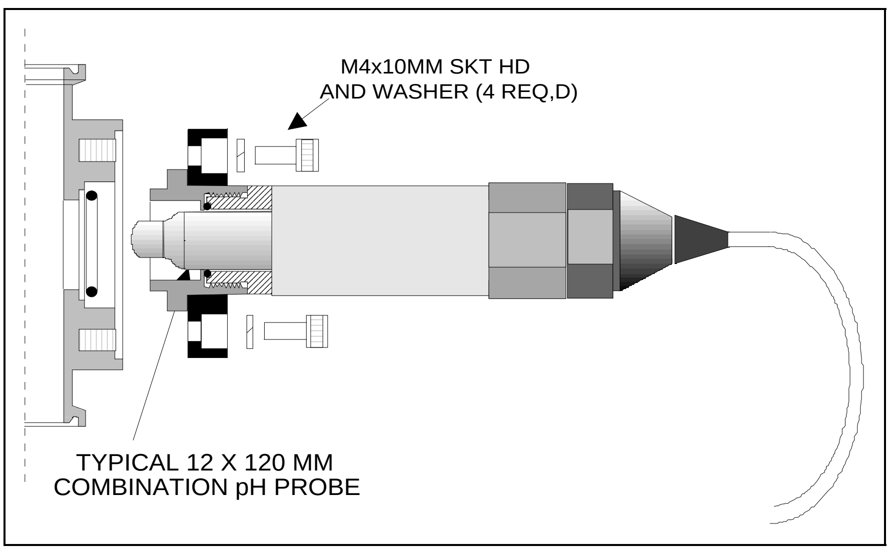

Fig. 7. pH Probe Installation and Assembly

The pH electrode is not shipped mounted, but protected in the original Manufacturer's packaging. The electrode is immersed in a buffer solution of 4.0 pH. Whenever the pH electrode is not in use, storage in a 4.0 pH buffer solution is advised. The installation of the pH electrode and its hardware are done in-situ. Before attempting installation please refer figure 7.

Carefully clean all parts prior to assembly. To install the probe, use the following procedure.

1. Slip an 'O' Ring over the electrode up to the back of the threaded cable connector.

2. Carefully insert the electrode into the housing.

3. Hand tighten the threaded connector end of the probe into the probe housing, securing the electrode in place.

4. Slip the second 'O' Ring over the electrode into the seal seat at the free end of the probe housing. Position the 'O' ring in the seat.

5. Insert the electrode and the housing in the pH probe adapter and tighten clockwise until the housing seats.

Note: All seals are designed for controlled compression on the 'O' rings. Therefore only hand tightening is needed.

5.0 Model 702 pH Monitor Operation and Calibration

5.1 Model 702 Front Panel Control Functions

The front panel controls and their location are shown in Figure 8.

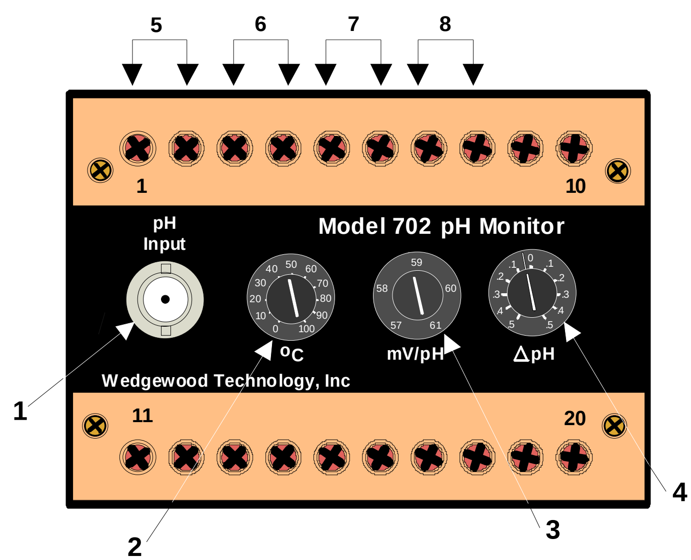

Fig. 8. Model 702 Front Panel Controls and Location

1. The **BNC** input connector for the pH probe.

2. The **'°C'** control manually adjusts for temperature compensation to cancel the Nerstian effects on the pH signal. Set the operating temperature on this dial.

3. The **'mV/pH'** adjusts the slope response of the pH probe. Adjustment should be made with the probe immersed in either a 4.00 pH or a 10.0 pH solution.

4. The '**Delta pH'** control compensates for the probe response at 7.00 pH when the **'°C'** control is at 25°C and the mV/pH control is at 59.2 mV/pH. (Temperature Compensation configured for Manual)

5. Connect Term. 1 and 2 for Automatic Temperature compensation.

6. Connect Term. 3 and 4 for Manual Temperature compensation.
7. Connect Term. 5 and 6 for 0-14 pH Full Scale.
8. Connect Term. 7 and 8 for 0-10 pH Full Scale.
9. Term. 5, 6, 7, and 8 open for 2-12 pH Full Scale.

5.2 pH Calibration and Standard Solutions

Before attempting to calibrate the pH sensor, using standard buffer solutions, clean the flowcell with distilled water and cap one end. To calibrate the sensor use the following procedure.

5.3 pH Sensor Calibration

Note: Each buffer solution is specified from the manufacturer with a temperature correction pH value. It is important to use this corrected value when calibrating the instrument. Standard values are based on a temperature of 25° C.

1. Rinse the sensor and flowcell with distilled water several times.

2. Rinse the sensor with a buffer solution of 7.00pH to remove any remaining distilled water. Discard the buffer used to rinse the sensor. Do this several times, then fill the sensor with this buffer. Adjust the **'Delta pH'** (Standard Adjust) control until the voltage/current analog outputs read as in Table 1.

Note: At temperatures other than 25° C, a correction is required for the buffer solutions (manufacturer supplied). See output calculation for voltage/current values.

pH Standard	0-10pH Range		2-12pH Range		0-14pH Range	
	VDC	mA	VDC	mA	VDC	mA
4.00pH	0.800	10.40	0.400	7.20	0.571	8.57
7.00pH	1.400	15.20	1.000	12.00	1.000	12.00
10.00pH	2.000	20.00	1.600	16.80	1.429	15.43

Table 1. Recorder Voltage and Current Output Vs. Selected Full Scale and pH Standards

1. Pour out the buffer solution and rinse the sensor with a pH 4.00 buffer solution. Do this several times, then fill the sensor with this buffer and adjust the **mV/pH** control until the voltage/current analog outputs read as in Table 1.

2. Repeat steps 2 and 3 until no further adjustments are necessary.

3. When the above steps are completed, rinse the sensor with a buffer solution of 10.00 pH. Do this several times and then fill the sensor with this solution. If the reading deviates from that in Table 1 significantly, pH electrode cleaning or replacement is indicated.

4. The response time of the measurements should be less than 30 seconds. If during the above procedure, the response of the electrode is longer, pH electrode cleaning or replacement is indicated.

5. This completes the calibration of the Model 702 pH Monitor with the pH probe.

The voltage/current analog output values may be calculated as follows:

$$\frac{\left(\begin{array}{c}\text{pH Solution Value}\\ \text{(Temp Corrected)}\end{array} - \text{Min Scale}\right)}{\text{(Full Scale - Min Scale)}} \times 2 = \text{VDC Output}$$

$$(\text{VDC Output} \times 8) + 4 = \text{mA Output}$$

Example: 7.00pH Solution, Range 0-10pH

$$\frac{(7.00 - 0)}{(10 - 0)} \times 2 = 1.400 \text{ VDC}$$

$$(1.400 \times 8) + 4 = 15.20\text{mA}$$

6.0 Model 702 Transmitter and Sensor Maintenance

6.1 Model 702 pH Monitor Maintenance

The Model 702's electronics have been designed and manufactured for a long and trouble free life. Failure of the system in most cases is due to electrical connection failure. If, however, it is determined that one of the printed circuit boards has failed, return the defective unit to Wedgewood Analytical for repair and re-calibration.

6.1.1 Removing Module Case

The rail mount terminals and top lid are fastened to the enclosure body with four (4) screws and side friction latches. To remove the enclosure lid, remove the 4 screws and then with a blade screw-driver, depress the latch and lifting the lid until the latch is disengaged. Repeat for the opposite side. When the lid is free, carefully remove the enclosure box.

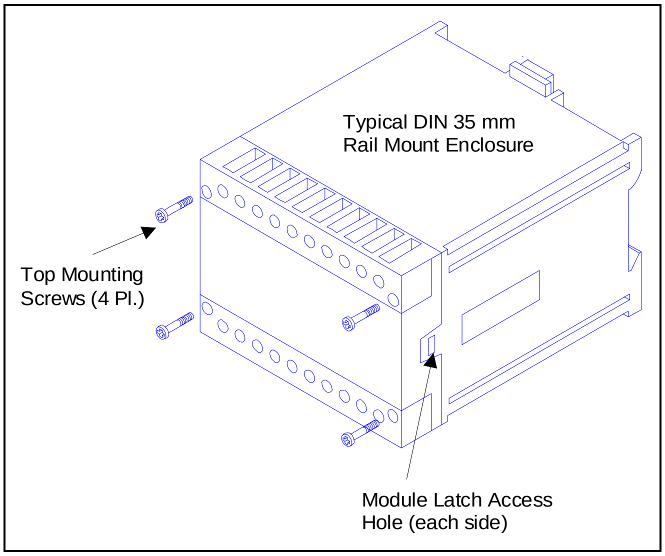

Fig. 9. Accessing Rail Mount Enclosure Interior PCB

6.1.2 Fuse Replacement

The instrument's fuses are located on the main PCB. Fuse failure is normally caused by improper voltage selection and/or faulty wiring. Replace the fuse with the type and rating installed. If after fuse replacement and if the installation is correct, the fuse fails again, this is an indication that an internal fault has occurred. Return the instrument to Wedgewood for repair

6.1.3 Changing Input Power

For AC powered instruments, refer to the Terminal Identification label on the enclosure side panel for wiring of 115Vac and 230Vac. DC powered units will operate with a supply Voltage of between 20 and 28Vdc.

6.1.4 Analog Output Interfacing.

A 0-2Vdc output is available and independent of the 4 - 20mA analog output. This allows both current and voltage input devices to be used simultaneously. The voltage output is referenced to circuit common. The current limit of the 0-2Vdc recorder output is 5mA. Therefore the output should be used with high impedance measuring instruments (i.e. 10,000 ohm/volt minimum).

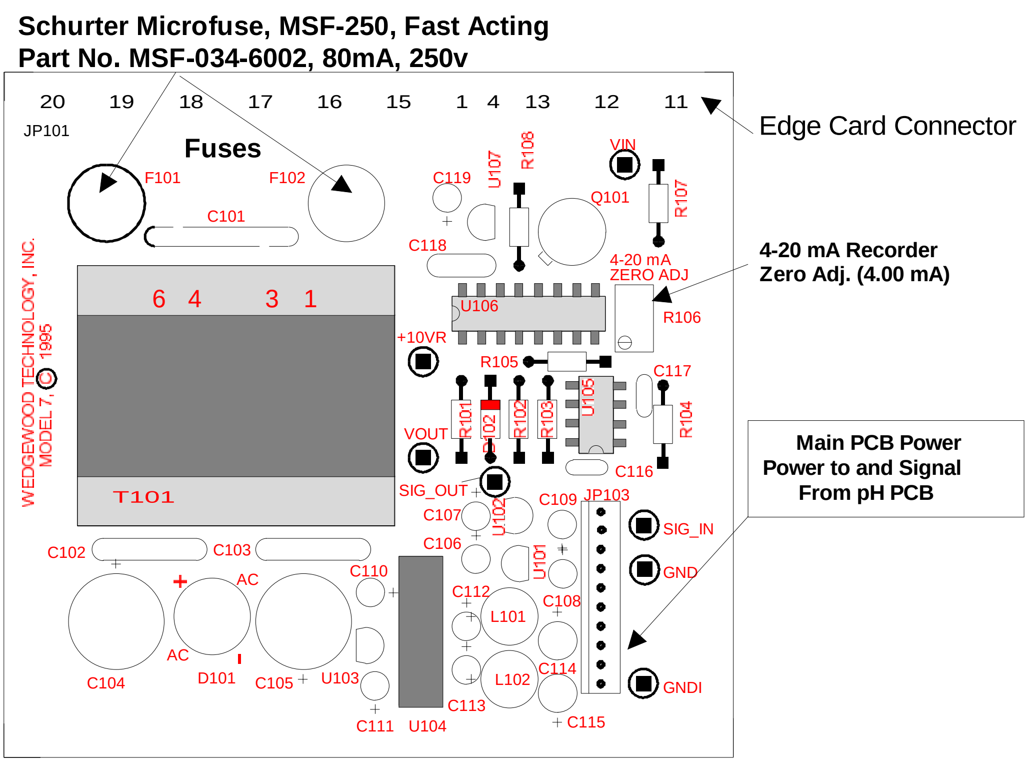

Fig. 10. Power Supply and Recorder Output PCB and Fuse Location

6.2 Sensor Maintenance

Under normal operating conditions, the Inline Sensors require no routine maintenance. What maintenance is required is usually restricted to 'housekeeping'. Inspect from time to time for signs of leakage, cable fraying, or any abnormal conditions. If sensor cleaning and/or maintenance is required, remove the sensor from service and perform the needed maintenance.

7.0 Replacement Parts

Description	Wedgewood Part Number
pH Probes and Cables	
Standard ISI pH probe, Quick Disconnect	1600-1200-00
Standard ISI Cable, 10 feet long	1957-0130-00
Standard ISI Cable, 25 feet long	1957-0140-00
Ingold DPAS pH Probe, 12 mm Diameter by 120 mm Long	1600-1002-00
Ingold Cable, 1 meter, BNC Connector	A050-0600-01
Ingold Cable, 2 meter, BNC Connector	A050-0600-02
Ingold Cable, 3 meter, BNC Connector	A050-0600-03
Ingold Cable, 5 meter, BNC Connector	A050-0600-05
Ingold Cable ,10 meter, BNC Connector	A050-0600-10
Ingold Cable ,20 meter, BNC Connector	A050-0600-20
Flowcell Seal Kits	
Silicon Rubber Seal Kit	A000-0605-00
Viton Seal Kit	A000-0605-01
Kalrez Seal Kit	A000-0605-04
EPDM Seal Kit	A000-0605-05
Fuses	
Fuse, AC Version, 80mA - 250V	1678-0018-80
Fuse, DC Version, 160mA - 250V	1678-0019-00

W A R R A N T Y

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